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[1 *front*]

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THE MINERALOGICAL MAGAZINE

AND

JOURNAL OF

THE MINERALOGICAL SOCIETY

No. 187 December, 1944 Vol. XXVII

Boracite from a boring at Aislaby, Yorkshire.[1]

By E. M. Guppy, B.Sc.

With a chemical analysis by C. O. Harvey, B.Sc., A.R.C.Sc., F.R.I.C.

Geological Survey and Museum of Great Britain.

[Communicated by Dr. J. Phemister; read June 8, 1944.]

CUTTINGS from their Eskdale no. 2 boring, Aislaby, near Whitby, at a depth of 4095–4100 feet from the surface were presented to the Geological Museum by the D'Arcy Exploration Co. Limited, in response to a request for a specimen from the Permian Saliferous Series which might contain polyhalite, a mineral already recorded by Professor C. E. Tilley from this boring (Min. Mag., 1943, vol. 26, p. lvii). The cuttings were examined by Dr. J. Phemister who found no polyhalite in them, but a small quantity of a mineral which he thought was probably boracite. In response to a request for additional material the company very kindly supplied further cuttings from depths in the bore between 4090 and 4150 feet. The bore journal records at this depth interbedded salt and anhydrite; the cuttings consist only of anhydrite with some dolomite and quartz and scarce boracite, the salt having been removed in solution. Thirteen samples having an approximate total weight of 146 grams yielded by hand-picking 0·3715 gram of boracite, i.e. 0·25%.

The boracite occurs as colourless to greyish-white translucent crystals suggesting isometric form and having a corroded appearance with dull vitreous lustre. Colonies of these crystals sometimes appear, the size of the groups ranging up to about $\frac{3}{8}$ inch in length. Their hardness is about equal to that of quartz, and the crystals scratch the blade of a pocket-knife with ease.

The specific gravity was taken by means of a specific gravity bottle from which the air was excluded by a vacuum pump before filling up with distilled water. The value obtained was 2·95.

Mr. C. O. Harvey made a micro-chemical analysis (Lab. no. 1316) on 0·14 gram of the material, and his report is as follows:

SiO_2.	$Fe_2O_3+Al_2O_3$.	MnO.	CaO.	MgO.	B_2O_3.	Cl.	Less O for Cl.	Total
0·5	2·3*	trace*	0·2*	31·0	60	8·6	2·0	100·6

* Figures obtained spectrographically in collaboration with J. A. C. McClelland.

[1] Communicated by permission of the Director, Geological Survey and Museum.

'Atomic ratio Mg : B : Cl = 7·1 : 16 : 2·2. These figures indicate that the samp is boracite, but the analysis shows an excess of Mg and Cl. It seems unlikely tha the departure from the ideal ratio 7 : 16 : 2 is due to experimental error, bu confirmatory work should be done if the discrepancy is of sufficient interest t rouse controversy.' Details of the method of analysis have been given by C. Harvey (1943).

Separate crystals were crushed and examined microscopically in oils. Twin ning was observed, in some cases simple, but often repeated and complex, yieldin between crossed nicols a lattice pattern resembling that of microcline. Th mineral is biaxial, with a large optic axial angle and positive sign. Refracti index values were found to be α 1·658, β 1·662, γ 1·668, $\gamma-\alpha$ 0·010 (sodium light).

Some of the crushed material was mounted in Canada balsam (slide no. E199 and a series of readings on selected fragments made on the universal stag Eight measurements of the optic axial angles enclosing the acute bisectrix ga an average value 2V 82½°, the values ranging from 80° to 85°. Four measure ments of the angle enclosing the obtuse bisectrix gave the average value 2V 82 but the range of variation was considerably greater, namely 79° to 88°. Co rections were made for refractive index (1·649) of the glass sphere used.

Recent work on boracite has had reference mainly to crystal structure an chemical composition, and for the optical properties we are still dependent o the values obtained by Mallard, Marbach, and Boeke (Rosenbusch, 1927). It apparent that the refractive indices show considerable variation as seen fro the following table, and it is unfortunate that optical determinations have no accompanied the recent work on internal structure.

	α.	β.	γ.	$\gamma-\alpha$.	2V.
Boracite (Locality ?)[1]	1·6622	1·6670	1·6730	0·0108	83° 34′
„ (Aislaby)	1·658	1·662	1·668	0·010	82½°

The chemical analyses of boracite also vary, but the data are not sufficien to correlate optical with compositional differences. The chemical formula for th mineral was discussed by Gruner (1928) who, from an analysis by G. Ward o boracite from Eime near Hanover and as the result of X-ray examination, pro posed the formula $Mg_6Cl_2B_{14}O_{26}$ in place of the formula $Mg_7Cl_2B_{16}O_{30}$ originall given by Heintz (1859). Gruner pointed out that chlorine was in excess of tha required by Heintz's formula, and showed that the latter conflicted with th X-ray measurements. Gruner's formula was supported by more recent work b Mehmel (1934), who further suggested that the differences in composition show by the fourteen chemical analyses available might be explicable by solid solutio of the components $Mg_6Cl_2B_{14}O_{26}$ and $Mg_7Cl_2B_{16}O_{30}$. It will be observed from th following table that the boracite from the Eskdale bore contains $MgCl_2$ in almo the mean of the proportions demanded by these two formulae.

[1] E. Mallard (1883, p. 134), calculated from his measurement $\beta-\alpha$ 0·00597, incorporatin Des Cloizeaux's values n 1·667 (taken as β) and V 41° 47′. (On p. 129 he gives Des Cloizeaux V as 41° 26′.) A. Des Cloizeaux in his 'Nouvelles recherches sur les propriétés des cristau (1867, pp. 517, 719) and 'Manuel de minéralogie' (1874, vol. 2, p. 4) gave for 'monorefringen boracite at 15° C. n 1·663 (red), 1·667 (yellow), 1·675 (blue), but no value for 2V.

	$MgCl_2$.	MgO.	B_2O_3.	Total.
$_7Cl_2B_{16}O_{30}$	10·65	27·05	62·30	100
racite (Aislaby)	11·8	26·7	61·5	100
$_6Cl_2B_{14}O_{26}$	12·14	25·71	62·15	100
racite (Eime)	12·35	26·39	61·26	100

There does not appear to be any previous record of the occurrence of boracite the British Isles.

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The X-ray pattern of low-temperature cristobalite.

By A. H. Jay, Ph.D., F.Inst.P.

Central Research Department, The United Steel Companies Limited, Stocksbridge, near Sheffield.

[Communicated by F. A. Bannister; read November 5, 1942.]

CRISTOBALITE is found as the first product in the conversion of quartz following a high-temperature heating, and it constitutes a large percentage of the crystalline material in most manufactured silica bricks. It is present also in fireclay products, the amount being dependent upon the nature of the raw material and the conditions of firing. In the majority of these products the cristobalite is only poorly developed, i.e. the crystals are only perfect over distances of the order of about 1×10^{-6} cm. This value is derived from the diffuseness of the high-order reflections on the X-ray powder photograph. On the other hand, the crystals of cristobalite are well developed in the hot face of an open hearth silica roof-brick. This crystal growth is due undoubtedly to a high flux or mineralizing content of the slagged working face in conjunction with a temperature of 1500–1700° C. It has been our experience that the X-ray powder pattern of this cristobalite is not changed, as regards both relative line intensities and lattice dimension, by the nature or amount of the constituents present.

X-ray studies of single crystals by Nieuwenkamp[1] have already shown that low-temperature or α-cristobalite is tetragonal. The present work confirms tetragonal symmetry, gives indexed powder data, and deduces accurate lattice dimensions.

A sample of the cristobalite zone from a silica roof-brick was ground in an agate mortar. The powder was repeatedly digested in hydrochloric acid and washed until only traces of impurities could be detected in the solution. Powder photographs were taken of two samples in a cylindrical camera, diameter 19 cm., using cobalt Kα radiation; one sample only 0·3 mm. in diameter packed into a capillary tube to obtain sharp lines for the longer spacings, and the second sample diameter 0·8 mm. prepared with Canada balsam solution to obtain an intense line pattern of the shorter spacings in a reasonable time.

Table I. Powder data for low-temperature cristobalite. Diameter of specimen 0·3 mm. Camera diameter 19 cm. Taken with filtered cobalt radiation $K\alpha_1$ 1·78529, $K\alpha_2$ 1·78919 kX.

Intensity.	$\sin\theta$. Observed.	$\sin\theta$. Calculated.	Indices.	Interplanar spacing kX units.	Intensity.	$\sin\theta$ Observed.	$\sin\theta$ Calculated.	Indices.	Interplanar spacing kX units.
vs	0·2212	0·2217	101	4·03	m	0·4642	0·4642	113	1·924
m	0·2849	0·2856	111	3·13	m	0·4784	0·4786	212	$1·866_5$
ms	0·3145	0·3152	102	$2·83_5$	vw	0·5090	0·5092	220	$1·754_5$
s	0·3595	0·3601	200	$2·48_1$	w	0·5176	0·5175	004	$1·726_3$
w	0·3628	0·3630	112	$2·46_1$	wm	0·5295	0·5294	203	$1·687_2$
wm	0·4228	0·4229	211	2·112	vw	0·5481	0·5479	104	$1·630_8$
wm	0·4432	0·4434	202	2·015	m	0·5554	0·5554	301	$1·608_4$

[1] W. Nieuwenkamp, Zeits. Krist., 1935, vol. 92, p. 82. [M.A. 6–329.]

In-nsity.	Sin θ Ob-served.	Sin θ Cal-culated.	Indices.	Inter-planar spacing kX units.
	0·5593	0·5592	213	$1·597_5$
broad	0·5701	0·5694	310	1·569
		0·5712	222	1·564
	0·5841	0·5839	311	1·530
	0·5990	0·5989	302	$1·491_8$
m	0·6253	0·6254	312	$1·428_5$
	0·6307	0·6305	204	1·4168
	0·6404	0·6403	223	1·3951
m	0·6554	0·6552	α_1 α_2 214	1·3627
	0·6568	0·6566		
w	0·6617	0·6615	α_1 α_2 321	1·3494
	—	—		
w	0·6648	0·6646	α_1 α_2 303	1·3431
	—	—		
m	0·6712	0·6709	α_1 α_2 105	1·3305
	0·6726	0·6724		
m	0·6888	0·6886	α_1 α_2 313	1·2963
	0·6903	0·6901		
m	0·6985	0·6983	α_1 α_2 322	1·2784
	0·7000	0·6998		
w	0·7256	0·7255	α_1 α_2 224	1·2304
	—	—		
	0·7314	0·7312	α_1 α_2 401	1·2209
	0·7329	0·7326		
m	0·7420	0·7418	α_1 α_2 410	1·2034
	0·7437	0·7434		
	0·7559	0·7558	α_1 α_2 323	1·1812
	—	—		
	0·7615	0·7613	α_1 α_2 215	1·1725
	0·7632	0·7630		

In-tensity.	Sin θ Ob-served.	Sin θ Cal-culated.	Indices.	Inter-planar spacing kX units.
vw	0·7689	0·7688	α_1 α_2 314	1·1610
	—	—		
vw	0·7743	0·7742	α_1 α_2 331	1·1529
	—	—		
w	0·8060	0·8059	α_1 α_2 332	1·1076
	0·8078	0·8077		
m	0·8150	0·8149	α_1 α_2 421	1·0954
	0·8166	0·8167		
		0·8163	α_1 α_2 116	1·0935
	0·8182	0·8181		
vvw	0·8229	0·8226	α_1 α_2 225	1·0852
	—	—		
vw	0·8298	0·8296	α_1 α_2 324	1·0760
	—	—		
vvw	0·8371	0·8371	α_1 α_2 413	1·0664
	—	—		
wm	0·8452	0·8451	α_1 α_2 422	1·0563
	0·8470	0·8470		
vw	0·8564	0·8562	α_1 α_2 333	1·0427
	0·8582	0·8581		
w	0·8611	0·8611	α_1 α_2 315	1·0367
	0·8630	0·8630		
wm	0·8933	0·8932	α_1 α_2 423	0·9993
	0·8952	0·8952		
wm	0·8997	0·8996	α_1 α_2 500	0·9922
	0·9016	0·9016		
m	0·9043	0·9042	α_1 α_2 414	0·9872
	0·9063	0·9062		

vs very strong, s strong, ms moderately strong, m moderate, wm weak moderate, w weak, vw very weak, vvw just visible.

Indices of other lines are 501, 325, 334 and 107, 511, 502, 306, 424, 316, 405, 207, 521, 503, 415, and 217 (θ = 82·00° (α_1) 83·00° (α_2)).

The extrapolated values[1] of the cell dimensions of α-cristobalite at 22° C., corrected for refraction, are a 4·9615, c 6·9054 kX; $a:c$ = 1:1·3918.

Summary. Cristobalite taken from the hot face of a used silica brick from an open-hearth furnace roof is found to be well crystalline with tetragonal symmetry. The line pattern with cobalt Kα radiation has been indexed and the lattice dimensions of the unit cell are a 4·9615, c 6·9054 kX units.

The author wishes to thank Dr. T. Swinden, Director of Research, The United Steel Companies Limited, for permission to publish this paper.

[1] Nieuwenkamp's values, a 7·02, c 6·92 kX (7·02 = $\sqrt{2} \times 4·965$).

The lattice parameters of α-alumina and chromic oxide.

By A. H. Jay, Ph.D., F.Inst.P.

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and W. T. Wilde,[1] Ph.D.

Refractories Department, Sheffield University.

[Communicated by F. A. Bannister; read November 5, 1942.]

DURING the course of a study of the interaction of certain pure refracto oxides at high temperatures it became necessary to obtain accurate valu for the lattice parameters of α-alumina and chromic oxide. Values obtained previous workers, listed in table I, did not attain a greater accuracy than o part in 2000, whereas the use of large-diameter powder cameras calibrated wi quartz now yield lattice parameters accurate to at least one part in 30,000.

Table I.

Author.	α-Alumina.		Chromic oxide.	
	a.Å.	α.	*a*.Å.	α.
W. P. Davey (1923)	5·11	55° 17′	5·33	55° 9
L. Pauling & S. B. Hendricks (1925) ...	5·12	55 17	—	—
V. M. Goldschmidt et al. (1925)	—	—	5·34	54 58
W. H. Zachariasen (1928)	5·13	55 16	5·35	55 0
E. A. Harrington (1927)	5·130	55 17	—	—
L. Passerini (1930)	5·130	55 6	5·38	54 50
P. E. Wretblad (1930)	—	—	5·348	55 18

Samples of the calcined oxides were examined in a 19 cm. diameter powd camera, alumina with cobalt Kα radiation and chromic oxide with chromiu Kα radiation. Results are given in tables II and III.

Table II. Powder data for calcined alumina, α-Al_2O_3, taken with filtered cobalt radiation $K\alpha_1$ 1·78529, $K\alpha_2$ 1·78919 kX.

Intensity.	Indices. Hexagonal.	Indices. Rhombohedral.	Sin θ Observed.		Sin θ Calculated.	Spacing kX units.
m	102	411	0·258		0·257	3·47
s	104	633	0·352		0·351	2·546
m	110	$30\bar{3}$	0·377		0·376	2·375
vs	113	630	0·430		0·429	2·083
s	204	822	0·515		0·514	1·736
vs	116	963	0·560		0·559	1·598
w	108	10.7.7.	0·593		$0·592_5$	1·508
s	214	930	0·638 0·639	0·638	0·637	$1·401_5$
vs	300	$6\bar{3}\bar{3}$	0·652 0·654	0·653	$0·651_5$	1·3709

[1] Recently killed by enemy action.

ıtensity.	Indices. Hexagonal.	Rhombohedral.	Sin θ. Observed.		Calculated.	Spacing kX units.
ns	1.0.10	12.9.9	0·723 0·725	0·724	$0·722_5$	1·2365
n	119	12.9.6	0·726 0·727	0·726	0·725	1·2316
rm	220	$60\bar{6}$	0·753 0·754	0·753	$0·752_5$	1·1873
r	306	12.3.3	$0·771_5$ —	0·772	0·772	1·1576
rm	223	$93\bar{3}$	0·780 0·782	0·781	0·780	1·1449
rm broad	312 218	$90\bar{3}$ 13.7.4	0·796	0·796	0·795 0·796	1·1235 1·1218
ı	2.0.10	14.8.8	$0·814_5$ $0·816_5$	0·815	0·8145	1·0967
	0.0.12	12.12.12	0·8266 —	0·8272	0·8268	1·0804
ı	314	$11.2.\bar{1}$	0·8301 0·8320	0·8307	0·8302	1·0759
s	226	12.6.0	0·8583 0·8604	0·8590	0·8584	1·0406
rm	402	$10.\bar{2}.\bar{2}$	0·8793 0·8815	0·8800	0·8796	1·0156
s	2.1.10	15.9.6	0·8968 0·8989	0·8975	0·8972	0·9957
m	404	12.0.0	0·9110 0·9132	0·9117	0·9114	0·9806
	321	$90\bar{6}$	0·9486 0·9507	0·9493	0·9492	0·9411
w	2.1.11	16.10.7	0·9507 —	0·9514	0·9511	0·9392
ıs	318	15.6.3	$0·9570_5$ $0·9591_5$	$0·9577_5$	0·9576	0·9328
	229	15.9.3	$0·9743_5$ $0·9764_5$	$0·9750_5$	0·9750	0·9162
ı	324	$12.3.\bar{3}$	$0·9853_5$ 0·9876	0·9861	0·9860	0·9060
s	1.0.14	16.13.13	0·9881 $0·9902_5$	0·9888	0·9887	0·9035

s very strong, s strong, ms moderately strong, m moderate, wm weak moderate, w weak, very weak.

The extrapolated values for the cell dimensions of alumina, α-Al_2O_3, are $1180 \pm 0·0001$ kX, α 55° 17′.

TABLE III. Powder data for calcined chromic oxide, Cr_2O_3, taken with filtered chromium radiation, $K\alpha_1$ 2·28503, $K\alpha_2$ 2·28891 kX.

tensity.	Indices. Hexagonal.	Rhombohedral.	Sin θ Observed.	Calculated.	Spacing kX units.
m	102	411	0·317	$0·315_5$	3·62
ms	104	633	$0·431_5$	0·430	2·660
m	110	$30\bar{3}$	$0·463_5$	0·462	2·475
w	006	666	0·507	$0·505_5$	2·262
m	113	630	$0·528_5$	$0·526_5$	2·171
m	204	822	0·6323 0·6332	0·6311	1·8121

Intensity.	Indices. Hexagonal.	Rhombohedral.	Sin θ Observed.		Calculated.	Spacing kX units
s	116	963	0·6859 0·6868	0·6862	0·6850	1·6696
wm	108	10.7.7	—	0·7265	0·7256	1·5773
	212	$71\bar{2}$	—		0·7250	1·5761
ms	214	930	0·7828 0·7837	0·7831	0·7821	1·4621
ms	300	$63\bar{3}$	0·8008 0·8019	0·8012	0·8002	1·4290
m	1.0.10	12.9.9	0·8838 0·8855	0·8844	0·8840	1·2937
wm	119	12.9.6	0·8881 —	0·8886	0·8881	1·2877
wm	220	$60\bar{6}$	0·9240 0·9256	0·9245	0·9240	1·2375
wm	306	12.3.3	$0·9464_5$ $0·9481_5$	0·9471	0·9466	1·2080
wm	223	$93\bar{3}$	0·9577 —	$0·9583_5$	0·9580	1·1936
m	312	$90\bar{3}$	0·9761 0·9777	$0·9766_5$	0·9766	1·1711

s strong, ms moderately strong, m moderate, wm weak moderate, w weak.

The extrapolated values for the cell dimensions of chromic oxide, Cr_2O_3, are a 5·3506±0·0001 kX, α 55° 6′.

Summary. Pure α-alumina and chromic oxide have been examined by means of the X-ray powder method. Tables are given showing intensities, indices (hexagonal and rhombohedral), and sin θ values from which accurate parameter values were calculated.

This paper is published by kind permission of Dr. T. Swinden, The United Steel Companies Limited, and Dr. Rees, The University, Sheffield.

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E. A. Harrington, Amer. Journ. Sci., 1927, ser. 5, vol. 13, p. 467.
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X-ray diffraction experiments on illite and bravaisite.

By G. Nagelschmidt, D.Ph.

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[Read November 2, 1944.]

UNPUBLISHED work carried out in this laboratory several years ago had shown that the first-order basal X-ray reflections of illite from South Wales[1] curred at a spacing of about 10Å. both with potassium- and calcium-saturated mples. Recently Jackson and others[2] observed that hydrated mica samples ving a 10Å. basal spacing when saturated with potassium, showed a 12 to 13Å. acing after saturation with calcium. They interpreted their results by ascribing illite a limited capacity for reversible lattice shrinkage and expansion, identical type with that known for montmorillonite.

In order to study the problem further three illite and two glauconite samples re treated with concentrated calcium chloride solutions for five weeks under quent renewal of the solution. At the end of the period, and at various intervals between, samples were washed until free from excess chloride, and their basal acings were determined by X-ray diffraction. Ordered aggregates[3] were made evaporation over 45% sulphuric acid (50% relative humidity), and hydrogen ssed through acid of the same strength was circulated through the X-ray nera during exposure.

Details of the samples and results are given in table I and illustrated by fig. 1. e 10Å. basal reflection of illite is not a sharp line, but a band of measurable lth, and spacings calculated for both edges of the band are given in the table.

Table I. Basal reflections, in Ångström units, of illite and glauconite samples before and after saturation with calcium.

	Before.	After.
Illite, South Wales	9·8–11·0	9·7–11·2Å.
Illite, Grundy County, Illinois (*a*)	9·7–11·4	9·7–12·5
Illite, Vermilion County, Illinois (*a*)	9·7–11·3	9·7–12·3
Fresh glauconite, Chobham Common, Surrey, England (*b*)	9·8–10·9	9·7–10·8
Fine fraction of weathered glauconite, Knaphill brickworks, Surrey, England	9·9–11·8	9·7–10·4 13·5–16·0

(*a*) Material kindly supplied by R. E. Grim.
(*b*) Material kindly supplied by C. O. Harvey.[4]

t may be seen that the illite from South Wales and the fresh glauconite showed change after the calcium-treatment; two other illite samples (from Illinois)

G. Nagelschmidt and D. Hicks, Min. Mag., 1943, vol. 26, pp. 297–303.
M. L. Jackson and N. N. Hellman, Proc. Soil Sci. Soc. Amer., [1942], vol. 6 (for 1941), 133–145. [M.A. 9–78.] N. N. Hellman, D. G. Aldrich, and M. L. Jackson, ibid., 1943, 7 (for 1942), pp. 194–200. [M.A. 9–78.]
G. Nagelschmidt, Journ. Sci. Instr., 1941, vol. 18, pp. 100–101. [M.A. 8–137.]
C. O. Harvey, Amer. Min., 1943, vol. 28, pp. 541–543. [M.A. 9–83.]

showed a small but distinct broadening of the basal reflection towards lar spacings; and the fine fraction of weathered glauconite showed in addition the 10Å. band a line at 15Å.

The following explanation is suggested. Illite is not a stable mineral un humid temperate conditions, and the first well-defined product of breakdown member of the montmorillonite group. The change is accomplished if all K– bonds are broken. But there may be intermediate stages where sufficient pot

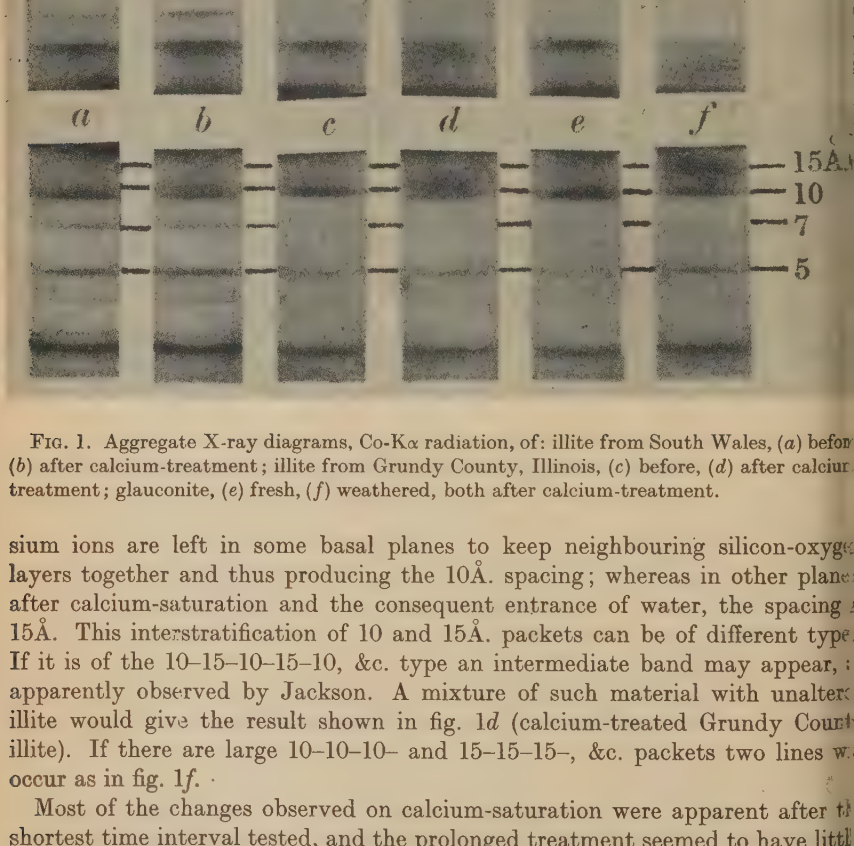

Fig. 1. Aggregate X-ray diagrams, Co-Kα radiation, of: illite from South Wales, (*a*) befor (*b*) after calcium-treatment; illite from Grundy County, Illinois, (*c*) before, (*d*) after calciu treatment; glauconite, (*e*) fresh, (*f*) weathered, both after calcium-treatment.

sium ions are left in some basal planes to keep neighbouring silicon-oxyg layers together and thus producing the 10Å. spacing; whereas in other plan after calcium-saturation and the consequent entrance of water, the spacing 15Å. This interstratification of 10 and 15Å. packets can be of different type If it is of the 10–15–10–15–10, &c. type an intermediate band may appear, apparently observed by Jackson. A mixture of such material with unalter illite would give the result shown in fig. 1*d* (calcium-treated Grundy Cou illite). If there are large 10–10–10– and 15–15–15–, &c. packets two lines w occur as in fig. 1*f*.

Most of the changes observed on calcium-saturation were apparent after t shortest time interval tested, and the prolonged treatment seemed to have litt if any, further effect, except possibly with the illite from Grundy County. Presum ably the weathered glauconite contained, apart from glauconite, a member the montmorillonite group, and the calcium-treatment only facilitated its iden fication. To what extent illite samples differ in resistivity to calcium chloride similar reagents remains to be seen. The few data reported above suggest th

te from shales and fresh glauconite (7·6% K_2O) may be more resistant than te from unconsolidated clays.

Obviously quantitative X-ray measurements combined with water and potash erminations would be required for a more detailed analysis, but in the writer's nion it should be accepted, almost one might say by definition, that the basal cing of illite is a multiple of 10Å., irrespective of the nature of the exchange- e ion. Inasmuch as observed X-ray diffraction effects differ, the materials uld be classed, as suggested by Hendricks,[1] as mixed illite-montmorillonite ictures.

According to Fleischer[2], bravaisite may be the specific mineral species in es. Through the courtesy of F. A. Bannister a sample of this mineral from type locality, Noyant, Moulins, Allier, France, was obtained from the British seum collection. Basal reflections of calcium-saturated material, *d* 11·2–9Å., were found to be distinctly larger than those of potassium-saturated terial, *d* 10·2–11·3Å. Small samples brought to equilibrium by drying over of 50% relative humidity at 20° C. and subsequently heated to 130° C. lost and 4·1% of the air-dry weight for calcium- and potassium-saturated samples. s difference is far greater than that found in parallel experiments with illite n South Wales. The bravaisite, while showing X-ray diffraction data similar hose described by Jackson and others (loc. cit.) would, according to the comnts made above, be classed as a mixed illite-montmorillonite structure.

S. B. Hendricks and L. T. Alexander, Soil Sci., 1939, vol. 48, pp. 257–272. [M.A. 9–78.]
M. Fleischer, Amer. Min., 1943, vol. 28, p. 470.

MINERALOGICAL ABSTRACTS

(Vol. 9, No. 4, December, 1944.)

New Minerals

ITH (W. Campbell), BANNISTER (F. A.), & HEY (M. H.). *A new barium-feldspar from Wales.* Nature, London, 1944, vol. 154, pp. 336–337.

Preliminary announcement of banalsite. [Min. Mag. **27**–33.] L. J. S.

TTON (C. Osborne). *Hydrogrossular, a new mineral of the garnet-hydrogarnet series.* Trans. Roy. Soc. New Zealand, 1943, vol. 73, pp. 174–180, 1 fig.

The 'garnets' of rodingite and garnetized gabbros from Dun Mountain, New land, have a lower refractive index than that of grossular (n 1·735, sp. gr. 3·53), ging 1·693–1·723 (with sp. gr. 3·39–3·47). In one specimen cores of n 1·723 are ntled by 1·693 and 1·678. Separated homogeneous material with n 1·7021, gr. 3·35, gave on analysis by F. T. Seelye SiO_2 34·48, TiO_2 0·03, Al_2O_3 19·87, $_2O_3$ 0·61, FeO 0·85, MnO 0·02, MgO 2·07, CaO 37·40, Na_2O 0·02, K_2O 0·01, $O+$ 4·65, H_2O- 0·23, CO_2 nil = 100·24; formula $Ca_{2\cdot9}(Al,Fe,Mg)_{2\cdot0}(SiO_4)_{2\cdot5}$ $H)_{2\cdot25}$. The name hydrogrossular is applied to members of the series $3CaO.Al_2O_3.3SiO_2$–$3CaO.Al_2O_3.6H_2O$ between grossular and hibschite (= plazolite, $_3O.Al_2O_3.2SiO_2.2H_2O$). [M.A. **8**–101, 145, 302, 343, 359.] L. J. S.

ASS (Jewell J.), JAHNS (Richard H.), & STEVENS (Rollin E.). *Helvite and danalite from New Mexico and the helvite group.* Amer. Min., 1944, vol. 29, pp. 163–191, 5 figs.

These minerals occur at Iron Mountain in Sierra and Socorro Counties [M.A. 06] in the metamorphic contact-zone between Palaeozoic limestone and tiary rhyolite and granite. The iron-rich silicate rock ('tactite') contains reciable amounts of beryllium and tungsten and is of economic importance; more common variety consists of magnetite and andradite; a banded variety obon rock') consists of magnetite, fluorite, helvine, &c. The amber-brown nahogany-red helvine is usually massive with tetrahedral crystals (usually = mm., some up to 12 mm. edge) in vugs; analysis gave SiO_2 31·54, TiO_2 0·01, O_3 0·37, BeO 13·60, FeO 18·02, MnO 26·51, ZnO 5·61, CaO 1·62 (partly as rite), S 5·34, H_2O 0·06 = 102·68, sp. gr. 3·334, n 1·746. Danalite is pale my yellow to honey-yellow; crystals embedded in fluorite show rounded ecahedral form, n 1·750–1·759. Helvine is closely associated with andradite ·865–1·885) and danalite with grossular (n 1·765–1·775), both of which they ely resemble in appearance: a staining test with H_2SO_4 and As_2O_3 or Sb is n to distinguish them. Of the more than fifty mineral species from this lity the following, in addition to the garnets, were found spectroscopically ontain beryllium: idocrase (SiO_2 36·19, TiO_2 trace, Al_2O_3 13·36, BeO 1·09, O_3 4·15, FeO 2·15, MnO 4·48, ZnO 0·43, MgO 2·42, CaO 32·02, Na_2O 0·22, 0·05, B_2O_3 0·11, F 3·22, H_2O+ 0·60, H_2O- 0·43 = 100·92, sp. gr. 3·3, 711, ω 1·718), pink epidotes (thulite, clinozoisite, piedmontite—optical data n), tilleyite (α 1·616, β 1·635, γ 1·651), and thuringite.

ata are given for material from other localities and the following values are

extrapolated for the end-members of the helvine series. The 'danalite' fro Colorado described by F. A. Genth (Dana's 6th edit., 1892, p. 1032) conta 85 % of the zinc end-member and is named *genthelvite*.

		Sp. gr.	*n*.	*a*.
Helvine	$Mn_4Be_3Si_3O_{12}S$	3·20	1·728	8·27Å.
Danalite	$Fe_4Be_3Si_3O_{12}S$	3·35	1·771	8·18
Genthelvite	$Zn_4Be_3Si_3O_{12}S$	3·70	1·740	8·10

L. J. S.

Kerr (Paul F.) & Young (Ford). *Hydrotungstite, a new mineral from Or Bolivia*. Amer. Min., 1944, vol. 29, pp. 192–210, 8 figs. [M.A. **8**–52.]

Tungstite, H_2WO_4 (previously thought to be WO_3), and hydrotungsti $H_2WO_4.H_2O$, are described from Calacalanti, dep. Oruro, as alteration product ferberite. Tungstite is yellow with resinous lustre and forms radial aggreg and earthy encrustations of minute orthorhombic prisms with perfect cleav (001) and prism angle 82°; α 1·82, γ 2·04, 2V 27°, negative, $Bx_a \perp$ (001); p chroism, α colourless, β and γ deep yellow, $\gamma > \beta > \alpha$; analysis by F. A. Gony gave WO_3 91·30, H_2O 7·46, SiO_2 0·96, Fe_2O_3 0·18 = 99·90. Hydrotungstit dark green with vitreous lustre and forms minute platy (001) crystals wi lamellar twinning; sp. gr. 4·60, H. 2; α 1·70, β 1·95, γ 2·04, 2V 52°, negat Bx_a about 3° to $\perp$ (001); pleochroism, α colourless, β yellow-green, γ dark gre $\gamma > \beta > \alpha$; analysis by F. A. Gonyer gave WO_3 80·31, H_2O 12·52, SiO_2 6·6 Fe_2O_3 0·08 = 99·56. Hydrotungstite loses half its water below 120°, being th converted into tungstite. X-ray powder data are given for the two minerals a the corresponding artificial compounds. L. J. S.

Frondel (Clifford) & Pough (Frederick H.). *Two new tellurites of iron: mackay and blakeite. With new data on emmonsite and "durdenite"*. Amer. Mi 1944, vol. 29, pp. 211–225, 5 figs.

These minerals from Goldfield, Nevada, have evidently been derived from t alteration of native tellurium and pyrite. Mackayite as small (< 1 mm.), gree tetragonal crystals gave goniometric measurements $a:c = 1:1·259$, forms a(10 m(110), f(112), g(012), and X-ray measurements a 11·70, c 14·95 Å., space-gro probably $I/4acd$; sp. gr. 4·86, H. 4½, ω 2·19, ϵ 2·21; formula 'perhaps $Fe_2(TeO_3)_$ not analysed. Blakeite as reddish-brown microcrystalline, isotropic (cubic crusts has n 2·16, and is 'provisionally classed as an anhydrous ferric tellurit Associated emmonsite forms green fibrous crystals with α 1·962, γ 2·12. X-r powder data are given for these, and also of another new (unnamed) Fe- mineral from Honduras and of artificial $Fe_2(TeO_3)_3$. Durdenite from Hondu is identical with emmonsite. L. J. S.

Krotov (B. P.). *On the problem of classification and nomenclature of miner within the groups of iron oxide hydrates*. Compt. Rend. (Doklady) Acad. S URSS, 1943, vol. 40, pp. 115–118.

The following dimorphous series is suggested:

Fe_2O_3.	Fe_2O_3.aq.	FeOOH.	FeOOH.aq.
Haematite	Hydrohaematite	Goethite	Hydrogoethite
Maghemite	—	Lepidocrocite	Hydrolepidocrocite

Extra water is adsorbed in hydrogoethite (α-FeOOH.aq.) and *hydrolepidocite* (γ-FeOOH.aq.). The term limonite should be restricted to meadow-ore bog-ore. L. J. S.

Topographical Mineralogy

SHOPP (D. W.). *A short review of Irish mineral resources.* Emergency Period Pamphlet, Geol. Surv. of Ireland [Eire], Dublin (Stationery Office), 1943, no. 1, 20 pp., 1 pl. Price 9*d*.

Brief notes are given on various Irish deposits of economic minerals, principally Eire. C. F. D.

YNNE (L. C.). *Mineral development in Eire.* Mining Mag. London, 1943, vol. 68, pp. 338–344, 2 figs. (maps).

An account of the present activities of the company formed by the government develop the mineral resources of Eire. Phosphatic rock containing 46 to 50 % cium phosphate occurring as lenticular beds in the Carboniferous Limestone being worked near Kilfenora and Doolin in Co. Clare. The Avoca mines in . Wicklow have been reopened for recovery of pyrite for sulphuric acid manuture. It is believed that the earliest mining in this district was for silver. bsequently very rich black oxide of copper was mined in the higher levels and pper-pyrites later. Magnetite is being worked at Ballycapple iron mine east of oca river. The reopening of the old lead mines at Glendalough is under nsideration. W. C. S.

SON (Brian). *Stockholms Högskola's collection of new and incompletely described minerals from Långban—a stocktaking.* Geol. För. Förh. Stockholm, 1943, vol. 65, pp. 80–82.

Of the 482 incompletely described mineral specimens from Långban listed by Flink [M.A. **2**–261; **3**–122, 443] a list is now given of those that have been ermined, including eight new species and ten new for Långban. References are en to the literature, and preliminary notes are given of later determinations h some X-ray data. L. J. S.

SON (Brian). *Some iron-manganese phosphate minerals from the pegmatite at Hühnerkobel in Bavaria.* Geol. För. Förh. Stockholm, 1942, vol. 64, pp. 335–340.

small specimen from Hühnerkobel (a hill at Rabenstein, between Zwiesel Bodenmais, in the Bavarian Forest) shows an intimate mixture of massive, k green arrojadite (α 1·754, γ about 1·785), alluaudite ($\alpha > 1{\cdot}77$), and trilite (sp. gr. 3·52, α 1·691, β 1·692, γ 1·697) with white eosphorite (sp. gr. , α 1·642, β 1·663, γ 1·669). L. J. S.

DIA (D. N.). *Rare earth minerals in Ceylon rocks.* Rec. Dept. Mineralogy, Ceylon, 1943, Prof. Paper no. 1, pp. 3–14.

ocalities in Ceylon are enumerated for minerals containing Ce, Yt, Be, Zr,

Th, Nb, Ta, U, Ti, Mo, and Li. They are obtained in small amounts from alluvial deposits derived mainly from pegmatite veins in the Khondalite system of deep-seated metamorphic rocks. Details are given of the occurrence of several minerals and chemical analyses of fergusonite, ilmenite, monazite, thorianite and zirkelite. L. J. S.

Dalloni (M.). *Géologie appliquée de l'Algérie: métallogénie—hydrogéologie—agrogéologie.* Paris (Collection du centenaire de l'Algérie: Masson & Cie), 1939, 888 pp., 3 pls., 4 maps.

The first section (pp. 31–214) of this book is concerned with the economic mineralogy of Algeria. Later sections describe the distribution of underground water (pp. 215–564) and the soils and land-forms (pp. 565–862). The work was apparently completed about 1930 and has been delayed in publication; consequently there are no references to the more recent literature. C. F. D.

Legoux (P.). *Esquisse géologique de l'Afrique Occidentale Française.* Bull. Service des Mines, Afrique Occidentale Française, Dakar, 1939, no. 4, v+134 pp., 16 text-figs., + geol. map (1:5,000,000).

Half this memoir comprises a useful synthesis of the geology of French West Africa, and half an account of the economic mineralogy. The minerals of greatest importance, actual or potential, are gold, diamonds, beach concentrates of ilmenite and zircon, bauxite, chromite, phosphates, rock-salt, and manganese ore. C. F. D.

Obermuller (A.). *Description pétrographique et étude géologique de la région forestière de la Guinée Française.* Bull. Service des Mines, Afrique Occidentale Française, Dakar, 1941, no. 5, xv+207 pp., 21 pls., 21 text-figs., + 3 geol. maps.

Petrographic descriptions of a wide variety of Archaean ortho- and para-gneisses, with frequent chemical analyses. The alluvial diamond fields of French Guinea are described: production in 1940 was 65,782 ct., principally bort. Deposits of alluvial gold, graphite, iron and manganese ores are also described. [A translation of portions of the chapter on diamond is given in the Gemmologist, London, 1944, vol. 14, pp. 1–4, 1 fig. (map).] C. F. D.

Legoux (Pierre) & Hourcq (Victor). *Esquisse géologique de l'Afrique Équatoriale Française.* Bull. Service des Mines, Afrique Équatoriale Française (Afrique Française Libre), Le Caire (Imprimerie de l'Institut Français d'Archéologie orientale), 1943, no. 1, xxi+96 pp., coloured map (1:3,500,000).

A general review of the geology of the vast territories of French Equatorial Africa, with references to the scanty previous literature. C. F. D.

Postel (A. Williams). *The mineral resources of Africa.* African Handbooks 2. Philadelphia (University of Pennsylvania Press), 1943, pp. vi+105, 1 pl., 19 text-figs.

A very useful handbook. For each mineral mined in the African continent

given Africa's annual production compared with the production of the world nd of the chief producer of the mineral. Prices and uses of most of the minerals re also given, and where available ore resources are included. A brief introuction gives a summary of the position of other countries as regards mineral roduction, reserves, and consumption, illustrated by useful tables, borrowed from cent publications. Madagascar is treated separately. An appendix tabulates ie geographical distribution of Africa's mineral production and reserves. There a short glossary and bibliography. W. C. S.

EALE (*Sir* E. O.) & OATES (F.). *The mineral resources of Tanganyika Territory.* Bull. Dept. Lands & Mines, Geol. Div. Tanganyika Territory, 1943, no. 16, viii+192 pp., 4 pls. Second edition.

Part I, dealing with minerals now being worked, includes gold (141,550 oz. in 941), diamond (29,052 carats [M.A. **7**–520]), tin ore (335 tons), mica [M.A. **8**–43], lt, and in small amounts Ag, Pb, W ores, bat-guano, red ochre, talc, and uilding materials. Part II gives details of occurrences of a long list of minerals at have not been worked, and Part III gives general information on a variety minerals. [M.A. **4**–182.] L. J. S.

RANKEL (J. J.). *Notes on some of the minerals in the Black Reef series.* Trans. Geol. Soc. South Africa, 1941, vol. 43 (for 1940), pp. 1–8, 1 pl., 1 text-fig.

Carbon does not replace the rock minerals but merely coats them or fills avage-cracks. The occurrence of sulphides, especially blende, and silicification e mentioned. The gold appears to be detrital, derived from the Witwatersrand stem, though exhibiting a certain amount of subsequent rearrangement. E. D. M.

HITESIDE (H. C. M.). *An unusual suite of minerals from a vug in a quartz vein in the Kimberley series, Daggafontein mines, Ltd.* Trans. Geol. Soc. South Africa, 1942, vol. 44 (for 1941), pp. 121–126, 1 fig.

A brief description is given of quartz, chlorite, dickite, a hydrocarbon resemng grahamite, galena, blende, chalcopyrite, pyrrhotine, and pyrite. E. D. M.

NDALE-BISCOE (R.). *Report on the geology and mines of the Insiza-Fort Rixon gold belt.* Short Rep. Geol. Surv. Southern Rhodesia, 1940, no. 32, 23 pp., 1 map.

This belt forms a lenticular outcrop of Basement Schists in granite about ×10 miles and running N.–S. through Fort Rixon. Reference is made to gold mines, mostly situated in a shear zone in the south-eastern part. E. D. M.

HTFOOT (B.). *Geological report on the Manesi gold belt.* Short Rep. Geol. Surv. Southern Rhodesia, 1940, no. 33, 8 pp., 1 map.

This belt, situated 20 miles NW. of Enkeldoorn, is itself about 40 miles long. consists of Basement Schists, largely banded ironstone, and is partly obscured Karroo basalt. The few mines described are of little economic importance. E. D. M.

Tyndale-Biscoe (R.). *Geology and mines of the Mashala district.* Short Re Geol. Surv. Southern Rhodesia, 1940, no. 34, 8 pp., 1 map.

This area, just west of Fort Victoria, is essentially granite with irregular tongu of Basement Schist. Gold, asbestos, and chrome deposits occur. E. D. M.

Macgregor (A. M.). *Geology of the Mafungabusi gold belt.* Short Rep. Ge Surv. Southern Rhodesia, 1941, no. 35, 26 pp., 2 pls., 1 map.

This area, about 40 miles west of Gatooma, consists of an irregular patch Basement Schists in granite, largely obscured by later formations. Gold mine occur in both schist and granite. Some 30 of the more important producers a described. E. D. M.

Rutherford (R. L.). *Kyanite from British Columbia.* Univ. Toronto Studie Geol. Ser., 1943, no. 48, pp. 102–103.

Translucent blue bladed kyanite up to 35 mm. long is found in quartz matr near Albreda (west of Jasper, Alberta). M. A. P.

Brownell (G. M.). *Chromite from Manitoba.* Univ. Toronto Studies, Ge Ser., 1943, no. 48, pp. 101–102, 1 fig.

A folded sill of peridotite-gabbro north of Bird river, SE. Manitoba, contai extensive bands of serpentine in which are disseminated crystals and grai (0·5 mm.) of chromite containing minute plates of haematite. M. A. P.

Thomson (Ellis) [–1944]. *Boulangerite and columbite-tantalite from Manitob* Univ. Toronto Studies, Geol. Ser., 1943, no. 48, p. 103.

Massive zinc-blende from Eskamanish river, NE. of Lake Winnipeg, co tains grains and blebs of galena and boulangerite (X-rayed), &c. Ore fro a pegmatite dike on Bird river, SE. of Lake Winnipeg, shows mainly granul columbite-tantalite (X-rayed) with some cassiterite and haematite.

M. A. P.

Jolliffe (A. W.). *Rare-element minerals in pegmatites, Yellowknife-Beaul area, Northwest Territories.* Paper Geol. Surv. Canada, 1944, no. 44–1 iii+23 pp., 7 pls. (mimeographed).

This area of 5000 sq. miles on the north side of the Great Slave Lake has sin 1938 yielded gold to the value of $14,000,000. Search for tungsten has been ma since 1940; and of the nearly 500 pegmatite intrusions examined in 194 tantalite-columbite was found in 100, lithium minerals (spodumene, amblygonit lithiophilite, petalite, and lepidolite) in 30, beryl in 228, and cassiterite in 2 These represent only about 1 % of the pegmatites in the region, and the pamphl is issued for the guidance of prospectors. The pegmatite veins are connected wi the younger granites which, together with the older granodiorite, are intrud into Archaean sediments. Tantalum content of the ore is estimated roughly fro the specific gravity, and a useful table gives sp. gr. 5·259–8·200 for 59 chemic analyses collected from the literature. L. J. S.

BINSON (J. Lewis). *Mineral resources and mining activity in the Canadian eastern Arctic.* Canadian Geogr. Journ., 1944, vol. 29, pp. 55–75, 27 figs.

An account is given of the geology and conditions in this difficult region. 'So mining activity has been unsuccessful in locating mineral deposits of present nomic value.' A list is given of known mineral occurrences: e.g. on the stern side of Hudson Bay, Keewatin: pitchblende and fluorite at Baker lake; Cu, Pt in pyrrhotine at Rankin inlet; molybdenite on Term island. Au, Ag, Pt, Ni, Sb, Fe, gypsum at Arctic bay, Baffin island. L. J. S.

IRAMM (E. F.). *Some minerals of Nebraska.* Rocks and Minerals, Peekskill, N.Y., 1943, vol. 18, pp. 323–326.

Only sedimentary rocks are exposed and these are largely covered by loess, cial drift, and 'sand hills'. Mineralogical specimens are consequently few. alcedony geodes filled with clear gypsum, and baryte concretions, occur in taceous shales. L. J. S.

neral resources of South Carolina. The Natural Resources of South Carolina, Columbia, S.C., 1944, Bull. no. 3, reprint, 13 pp., 1 fig. (map).

lays, limestones, and phosphates are exploited. Chemical analyses are ulated, and a short list is given of various minerals. L. J. S.

RDOCH (Joseph) & WEBB (Robert W.). *Notes on some minerals from southern California. III.* Amer. Min., 1942, vol. 27, pp. 323–330, 3 figs. [M.A. **7**–549, **8**–233.]

1) Linarite from Darwin, Inyo Co.—Small crystals are of two habits: short matic parallel to the *b*-axis, and thin tabular parallel to (100). Associated erals are aurichalcite, hemimorphite, hydrozincite, wulfenite, &c. (2) Ortho-e phenocrysts from Cinco, Kern Co.—Well-developed crystals (1–10 cm.) are ndant in rhyolite and are easily broken out of the weathered rock; they are rly all Carlsbad twins, occasionally Baveno twins, and less commonly simple stals. Quartz bipyramids are also abundant. (3) Hemimorphite from Lead mine, Barstow.—Crusts of minute crystals. (4) Corundum near Banning, Jacinto Mts.—Barrel-shaped crystals (14 inches long) with sapphire-blue s occur in xenoliths of biotite-schist in quartz-monzonite. (5) Zeolites from Rock Canyon, Mojave Desert.—Analcime and natrolite, with calcite, cedony, and quartz in amygdaloidal basalt. L. J. S.

ALLER (W. T.) & GLASS (Jewell J.). *Occurrence of pink zoisite (thulite) in the United States.* Amer. Min., 1942, vol. 27, pp. 519–524.

etails are given of occurrences in 12 States with several localities in some, cially in North Carolina. The mean (and limiting) values of 14 refractive x determinations are: α 1·695 (1·685–1·705), β 1·698 (1·688–1·710), γ 1·706)8–1·725). 2V 30–60°. Pleochroism is consistently α pale pink or rose, arly colourless, γ pale yellowish. The mineral occurs in: highly silicated act-metamorphosed limestones and dolomites; altered granitic rocks and sses; pegmatites; quartz veins (pegmatite?) and surrounding schist.

L. J. S.

Hodge-Smith (T.). *Mineralogical notes. No. VI.* Rec. Australian Museu 1943, vol. 21, pp. 244–256, 16 figs. [M.A. **6**–162.]

Fifteen analyses (7 of them new) of wolframite from various localities in N South Wales range in composition from $Fb_{86}Hü_{14}$ to $Fb_{71}Hü_{29}$. Small amount Ca, Mg, Nb, and Ta are also present; 14 crystal-forms are listed. Apophy crystals are recorded in quartzitic ore from Broken Hill, and with pectolit dolerite from Prospect, New South Wales. Cassiterite replaces the calcit fossils from Emmaville, N.S.W. A phosphate deposit beneath basalt at Cathca N.S.W., contains white fossil wood and bones of which analyses are given. octahedron of microlite (sp. gr. 5·43) is recorded from Euriowie, N.S.W. Sche from Hatcher's creek, Northern Territory; tantalite crystals from Finniss ri Northern Territory, show 7 forms including new *w* (164). L. J. S.

Radioactivity

Goodman (Clark) & Thompson (George A.). *Autoradiography of minera* Amer. Min., 1943, vol. 28, pp. 456–467, 11 figs.

Economical use was made of the stray neutrons escaping from a cyclotron exposing various minerals to the bombardment, whereby artificial radioactivi was induced. The specimens (with a flat ground surface) were then placed on photographic plate to record the β-radiation. Elements present are recogniz by their half-periods (a few minutes to several days; those of 1–10 hours bei preferred) of radioactivity excitation and decay. Trial tests were made wi minerals containing Mn, Au, Cu, W, P, K, Ba, Na, and As. Prints of the aut radiograms, with photographs of the specimens in ordinary light for compariso show the distribution of some of the elements present. L. J. S.

Hurley (Patrick M.) & Goodman (Clark). *Helium retention in common ro minerals.* Bull. Geol. Soc. Amer., 1941, vol. 52, pp. 545–559.

Age measurements by the helium method were made on a series of pyroxen and felspars from the Triassic Palisade diabases and Watchung basalts. Mea age ratios obtained were 103 million years for the pyroxenes and 36 millio years for the felspars. Specimens of Triassic magnetite give an average figure 134 million years. Similar work on magnetite samples from various geologic horizons give age ratios in fair agreement with those obtained by the lead metho Thus felspar retains less helium than pyroxene, while magnetite appears to reta most, if not all, of its helium. [M.A. **8**–154.] C. F. D.

Hurley (Patrick M.) & Goodman (Clark). *Helium age measurement. I. Pr liminary magnetite index.* Bull. Geol. Soc. Amer., 1943, vol. 54, pp. 305–32

Helium age measurements on seventy magnetite specimens from vario geological horizons give a grouping of results in good agreement with the strat graphical age sequence. Although helium leakage renders this method unsati factory for dealing directly with samples of igneous rock, it may be successful applied to separations of individual rock-forming minerals known to contain a or a constant definite proportion, of their radiogenic helium. C. F. D.

CKMAN (Frans E.). *Can the "lead method" be used on igneous rocks?* Arkiv Kemi, Min. Geol., 1943, vol. 16A, no. 23, 9 pp., 5 figs.

From the amounts of the isotopes Pb^{204}, Pb^{206}, Pb^{207}, and Pb^{208} found in an eous rock, formulae are given for calculating their relative abundance at the e of crystallization, and hence the age of the rock. L. J. S.

CKMAN (Frans E.). *A graph for the calculation of the age of minerals according to the lead method.* Årsbok Sveriges Geol. Undersök., 1944, vol. 37, no. 7 (Avhandl. och Upps., Ser C, no. 458), pp. 1–6, 1 pl., 2 text-figs.

'or values of Pb/(U+Th) and U/(U+Th) separate graphs are given showing s 10–100 and 100–3200 million years. [M.A. 7–497.] L. J. S.

CKMAN (Frans E.). *On the emanating power and the measurement of geological time.* Geol. För. Förh. Stockholm, 1943, vol. 64 (for 1942), pp. 465–476, 8 figs.

nless taken into account, the emanating power may, in certain cases, be a ce of error in age determinations. Formulae are given and plots of AcD/RaG RaG/UI for Swedish kolm ('diffusion age' 442 million years, compared with ious estimates ranging from 388 to 770 million years), thucholite, and inite. L. J. S.

ENQVIST (Ivan Th.). *Determination of lead in silicate rocks.* Amer. Journ. Sci., 1942, vol. 240, pp. 356–362.

ead was co-precipitated as sulphate with $SrSO_4$ as 'carrier' and determined olytically as PbO_2. Checked by the use of thorium B as radioactive indicator, method gives a better result than precipitation as sulphide with silver. wegian rocks (granite, gneiss, and nordmarkite) contain Pb 10–20 g. per ton. isotopic composition of this lead will be determined later for calculating the of the rocks. L. J. S.

ER (S. A.) & MARAIS (J. J.). *A method for the determination of the relative radioactivity of mineral grains.* Journ. Sedimentary Petrology, 1941, vol. 11, pp. 145–147, 1 fig.

embedding mineral grains in the softened gelatin film of 'fined-grained a particle plates' and counting the alpha-ray tracks after development with croscope using dark field illumination the relative radioactivity of the grains be measured. F. A. B.

N (Ernst), GLEDITSCH (Ellen), & ROSENQVIST (Ivan Th.). *The determination of radium in some igneous rocks.* Amer. Journ. Sci., 1941, vol. 239, pp. 805–808, 1 fig.

e rock is readily decomposed, even when not finely powdered, by heating NH_4HF_2 over an ordinary gas burner. SiF_4 is decomposed by NaOHaq. and absorbed by HCl, and radon is collected with the remaining gases in the ation chamber of an electrometer. Granite-gneiss from Hol, Opdal, Norway, $1{\cdot}11 \times 10^{-12}$ g. Ra per g. of rock, and augen-gneiss from Riise, Opdal, $< 10^{-12}$. L. J. S.

URRY (Wm. D.) & PIGGOT (C. S.). *Apparatus for determination of small quantit of radium.* Amer. Journ. Sci., 1941, vol. 239, pp. 633–657, 1 pl., 14 text-fi

The assemblage of apparatus with many accessories and improvements enab a radium content of the order 10^{-15}–10^{-10} g. per g. to be determined in rocks a sediments. The sample is heated in a high-temperature furnace, the evolv radon being carried in a stream of nitrogen to an ionization chamber with elect meter, and the number of emitted α-particles recorded on a moving photogra film. In oceanic deposits the amount of radium was determined as 1·06–2·3 10^{-12} g. per g. L. J. S.

PIGGOT (Charles Snowden). *Radium content of ocean-bottom sediments.* A Journ. Sci., 1933, ser. 5, vol. 25, pp. 229–238, 3 figs. [M.A. **5**–329.]

PIGGOT (C. S.) & URRY (W. D.). *The radium content of ocean-bottom core.* Jou Washington Acad. Sci., 1939, vol. 29, pp. 405–410, 1 fig.

PIGGOT (C. S.) & URRY (Wm. D.). *Radioactivity of ocean sediments. III. Rad activity relations in ocean water and bottom sediment.* Amer. Journ. Sc 1941, vol. 239, pp. 81–91, 1 fig.

—— —— —— *IV. The radium content of sediments of the Cayman trough.* Ib 1942, vol. 240, pp. 1–12, 3 figs.

—— —— —— *V. Concentration of the radio-elements and their significance in clay.* Ibid., 1942, vol. 240, pp. 93–103, 1 fig.

Determinations of radium in long cores show a rapid increase in amount wi depth in the deposit, followed by a gradual decrease. 'There is some radium bei deposited from the water, and also more ionium than is necessary to maint this particular radium concentration, but much less uranium than is requir to maintain this ionium concentration. The radium content therefore increa until equilibrium with ionium is established.' This lack of equilibrium in t uppermost layers of the sediments suggests a means of determining the rate deposition. L. J. S.

URRY (William D.). *Heat energy from radioactive sources in the earth.* Jou Washington Acad. Sci., 1941, vol. 31, pp. 273–284, 3 figs.

Elements of the U, AcU, and Th series are considered, and alpha-particles a counted, H (calories per gram per year) $= 2{\cdot}1 \times 10^{-9}N$ (number of alpha-partic emitted per gram per hour). To this must be added the effect of the isotope of potassium. L. J. S.

SARKAR (T. C.). *The alteration of radioactive minerals.* Proc. Indian Acad. Sc Sect. B, 1941, vol. 14, pp. 261–270.

Discrepancies in the lead ratios are attributed to the action of percolati solutions. If Pb is partly present as plumbate and U as uranate, these would especially liable to removal by silicate solutions. L. J. S.

ALAPESI (A. S.), CHHAPGAR (S. K.), & SUKHESWALA (R. N.). *A note on the "lead-ratio" method for determining the age of the Deccan traps.* Current Science, Bangalore, 1941, vol. 10, pp. 526–528.

Age determinations made on fresh rocks from Bombay confirm the view that ere were distinct flows at different periods. Andesine-andesite gave U 20·988–·703 $\times 10^{-2}$ %, Th nil, Pb 13·531 $\times 10^{-4}$ %, corresponding to 45·6 million ars (Oligocene); and basalt gave U 11·686 $\times 10^{-2}$ %, Th nil, Pb 8·698–·598 $\times 10^{-4}$ %, corresponding to about 60 million years (Eocene). [M.A. 7-342.]

L. J. S.

UCHEMBLÉ (*M^lle* Georgette). *Sur la radioactivité élevée des roches marines du terrain houiller du Nord de la France.* Compt. Rend. Acad. Sci. Paris, 1943, vol. 216, pp. 270–271.

Ampelites (carbonaceous shales) rich in organic matter contain much more dium (up to 10·5 $\times 10^{-12}$ gram per gram of rock) than the limestones and neous rocks of the same district. L. J. S.

EEVIL (Norman B.). *The distribution of helium and radioactivity in rocks. I. Mineral separates from the Quincy granite.* Amer. Journ. Sci., 1938, ser. 5, vol. 36, pp. 406–416, 2 figs.

Determinations of He, Ra, U, and Th in the granite of Quincy [Massachusetts] ve an age of 62 million years, and in the isolated minerals: quartz 86, riebeckite d aegirine 86, felspar (mainly microperthite) 49, mean 68 million years. The romagnesian minerals contain most of the Ra, Th, and He. L. J. S.

EEVIL (N. B.). *The distribution of helium and radioactivity in rocks. II. Mineral separates from the Cape Ann granite.* Amer. Journ. Sci., 1942, vol. 240, pp. 13–21.

Determinations of He, Ra, and Th in different samples of the Cape Ann granite, sex Co., Massachusetts, and in the separated quartz, felspar, and ferric minerals rnblende, riebeckite, and some biotite) gave varying results for the helium ex (age in millions of years calculated from the helium-radioactivity equation). e mean results are: the rock 89, quartz 94, felspar 59, ferric minerals 159 lion years. Specimens examined after an interval of a year showed an escape helium, but much less from the ferric minerals. [M.A. 7–341, 8–154.]

L. J. S.

SEN (Esper S.) & KEEVIL (Norman B.). *The distribution of helium and radioactivity in rocks. III. Radioactivity and petrology of some California intrusives.* Amer. Journ. Sci., 1942, vol. 240, pp. 204–215.

he radioactivity and helium content were determined of tonalite and granoite and of the minerals separated from these rocks. Making allowances for varying retentivity of helium in the different minerals [M.A. 8–154], the ages 120–135 million years, corresponding to the Jurassic period. L. J. S.

KEEVIL (N. B.), JOLLIFFE (A. W.), & LARSEN (E. S.). *The distribution of helium and radioactivity in rocks. IV. Helium age investigations of diabase and granodiorites from Yellowstone, Northwest Territories, Canada.* Amer. Journ. Sci., 1942, vol. 240, pp. 831–846, 1 fig. (map).

The diabase is intrusive into the granodiorite, but the former gives higher helium values, indicating that the method is unreliable. The mean corrected helium indices for the two rocks and for the minerals separated from them are: diabase 1000, plagioclase 120, pyroxene 1640, olivine 810, magnetite 4800 (in one specimen 16,700); granodiorites 369 and 117, quartz 147, felspar 154 and 90, biotite and hornblende 585 and 264. The average radioactivity indices are: diabase 0·115, plagioclase 0·1, pyroxene 0·1, olivine 0·5, magnetite 0·1; granodiorites 1·04 and 0·53, quartz 0·52, felspar 0·35 and 0·23, biotite and hornblende 2·88 and 0·44. L. J. S.

KEEVIL (N. B.). *The distribution of helium and radioactivity in rocks. V. Rocks and associated minerals from Quebec, Ontario, Manitoba, New Jersey, New England, New Brunswick, Newfoundland, Tanganyika, Finland, and Russia.* Amer. Journ. Sci., 1943, vol. 241, pp. 277–306, 2 figs.

Further determinations of helium and radioactivity data (and of Ra and Th in some cases) in a number of rocks and their isolated minerals. L. J. S.

KEEVIL (N. B.), LARSEN (E. S.), & WANK (F. J.). *The distribution of helium and radioactivity in rocks. VI. The Ayer granite-migmatite at Chelmsford, Mass.* Amer. Journ. Sci., 1944, vol. 242, pp. 345–353.

More than half of the radioactivity of this rock is due to accessory minerals: zircon, epidote, and biotite have more than five times the radioactivity of the rock. Zircon has a radioactivity 10,000 times, and a content of helium (1·2 c.c. per gram) 150,000 times, that of the felspar. An excess of helium occurs in sphene and to a less degree in garnet. L. J. S.

KEEVIL (N. B.). *The helium method for determining the age of rocks.* Nature, London, 1941, vol. 148, pp. 445–446.

Retentivity of helium varies widely even in materials of the same kind, and the method is not reliable for age determination. Magnatite retains most of its helium, but material from several localities gave varying results. [M.A. **8**–154.] L. J. S.

KEEVIL (N. B.). *The unreliability of the helium index in geological correlation.* Univ. Toronto Studies, Geol. Ser., 1941, no. 46, pp. 39–67, 2 figs.

Two hundred new determinations of the geological age of rocks and minerals (including magnetite) by the helium method, together with 165 determinations by other workers, give ratios of measured age (I) to expected age (A) ranging from 0·01 to 25. Three crystals of garnet, of identical appearance, from Fort Wrangel, Alaska, give I 56, 130, 350 million years, respectively. I/A is commonly less than unity, indicating loss of helium, but the application of probable helium retention factors does not give reliable results. 'The helium method offers little promise of usefulness unless more effective methods of interpretation are devised.' [M.A. **8**–154.] M. A. P.

EEVIL (N. B.), KEEVIL (A. R.), INGHAM (W. N.), & CROMBIE (G. P.). *Causes of variations in radioactivity data.* Amer. Journ. Sci., 1943, vol. 241, pp. 345–365, 1 pl., 4 text-figs.

New data are given for rocks from various localities. There is further evidence at radioactivity is concentrated in zircon and apatite, which are irregular in eir distribution. L. J. S.

EEVIL (N. B.). *Helium indexes for several minerals and rocks.* Amer. Journ. Sci., 1943, vol. 241, pp. 680–693.

n a number of various minerals from Franklin Furnace and Sterling Hill, w Jersey, the helium content ranged $0{\cdot}13$–$65{\cdot}5 \times 10^{-4}$ c.c./g., and the activity phas/mg./hr.) 0·005–7·2. Values are also give for many minerals and rocks m other localities. L. J. S.

EEVIL (N. B.). *Thorium-uranium ratios in rocks and minerals.* Amer. Journ. Sci., 1944, vol. 242, pp. 309–321, 1 fig.

Many (100) recent determinations of Th and U taken from the literature ether with some new data are tabulated and the Th/U ratio plotted on fre-ncy distribution curves. A probable value of 3·2 is indicated for igneous ks. The results do not support Holmes's theory [M.A. **7**–158, 439] of the deep-ted genesis of lead ores. L. J. S.

ORI (Takeo). *The microgranular uraninite from Iisaka and its absolute age.* Amer. Journ. Sci., 1941, vol. 239, pp. 819–821

linute (0·01–0·2 mm.) grains of uraninite, sometimes showing octahedral n, are finely disseminated, together with fergusonite, &c., in pegmatite at ka, Abukama range, Japan [M.A. **7**–225, 357]. About 200 grams of material isolated from 2–3 tons of the rock. Analysis gave UO_3 22·23, UO_2 55·40, $)_2$ 3·86, Yt earths 14·60, Ce earths 0·41, PbO 1·01, Bi_2O_3 0·00, $(Nb,Ta)_2O_5$ 0·74, $_2$ 0·11, Al_2O_3 0·44, Fe_2O_3 0·17, CO_2 0·28, H_2O 0·50 = 99·75, Ra $2{\cdot}31 \times 10^{-7}$ g. g. The Pb/(U+0·36Th) ratio gives an age of 103 million years. L. J. S.

RENCIO (Willer) & CASTRO (Celso de). *Uraninita em Minas.* Anais Acad. Brasileira Sci., 1943, vol. 15, pp. 19–29, 3 figs.

n analysis, the method of which is described, uraninite from Rio Branco, ict of Engenho Central, Minas Geraes, Brazil, gives: UO_3 49·21, UO_2 41·94, [*sic*] nil, PbO 5·71, SiO_2 0·92, Fe_2O_3 0·30, CaO 0·42, loss ign. 1·22 [= 99·72], Ra 24×10^{-6} %. The Pb/U ratio gives an age of 503 million years. . **8**–157.] C. F. D.

IRO (J. Costa). *Nota prévia sôbre o elevado teor em radium de um mineral brasileiro.* Ann. Acad. Brasil. Sci., 1940, vol. 12, pp. 341–346, 2 figs.

adioactive determinations of an unnamed mineral [presumably pitchblende] Rio Blanco and Conceição, Minas Geraes, showed 232–273 (mean 253) mg. adium per ton, as compared with 210 for pitchblende from Jáchymov, mia. [M.A. **8**–157.] L. J. S.

Marble (John Putnam). *Allanite from Barringer Hill, Llano County, Texa* Amer. Min., 1940, vol. 25, pp. 168–173.

The specimen examined is only slightly radioactive, and is optically isotrop with n 1·716. Like other rare-earth minerals from this pegmatite it is in altered metamict condition. Analysis gave SiO_2 29·89, TiO_2 0·89, Al_2O_3 19·0 Fe_2O_3 6·41, FeO 8·49, Ce_2O_3 10·58, La_2O_3 &c. 11·97, Yt_2O_3 &c. 0·81, ThO_2 0·8 U_3O_8 0·04, MgO 0·15, CaO 8·48, SrO 0·00, Na_2O 0·16, K_2O 0·08, Pb 0·12, S 0·33, H_2O+ 1·84, H_2O- 0·22 = 100·37, D_4^{25} 3·54. The high lead and low hel (1·98 × 10^{-2} c.c./g.) give discordant results for an age determination. L. J. S.

Marble (John Putnam). *Possible age of allanite from Whiteface Mountai Essex Co., New York.* Amer. Journ. Sci., 1943, vol. 241, pp. 32–42, 3 pl.

Allanite, anisotropic and strongly pleochroic, from granite-pegmatite pe trating anorthosite gave SiO_2 32·72 (32·84), TiO_2 0·64 (1·13), ThO_2 1·20 (0·5 ZrO_2 0·13 (0·10), U_3O_8 0·08 (0·01), Ce_2O_3 3·73 (3·08), Yt_2O_3 &c. 0·12 (0·06), La &c. 15·46 (18·84), Al_2O_3 18·28 (9·47), Fe_2O_3 8·36 (14·19), FeO 5·42 (7·70), M 0·63 (n.d.), MgO 0·44 (1·33), CaO 11·28 (9·30), SrO 0·14 (0·05), Na_2O 0·17 (0·1 K_2O 0·26 (0·30), Pb 0·08 (0·14), H_2O+ 0·41 (0·88), H_2O- 0·29 (0·11), to 99·84 (100·14), sp. gr. 3·55 (3·79). The ratio Pb:(U+0·36Th) = 0·167 cor sponds to an age of about 1200 million years, agreeing with the geological relatio (pre-Cambrian and post-Grenville). A comparative analysis (figures in bracke was made of allanite associated with magnetite and zircon from the iron mine Mineville, Essex Co., N.Y. This material is altered and almost isotropic, and t ratio Pb:(U+0·36Th) = 0·89 is meaningless for age determination. L. J. S.

Bliss (Allen Douglass). *Radioactive substances. III. The analysis and age o North Carolina monazite.* Amer. Journ. Sci., 1944, vol. 242, pp. 327–330.

A crystal of monazite (sp. gr. 5·18) in pegmatite from Spruce Pine, Mitchell C gave Th 4·83, U 0·02, Pb 0·13 %, corresponding to an age of about 600 milli years. [M.A. **6**–521.] L. J. S.

[Komlev (L. V.) & Gerling (E. K.)] Комлев (Л. В.) и Герлинг (Э. Komlev (L. V.) and Herling (E. K.). *On the age of Khibiny tundras.* Com Rend. (Doklady) Acad. Sci. URSS, 1940, vol. 26, pp. 939–941.

Pure crystals of loparite [M.A. **3**–275, **8**–223] from pegmatite in foyaite Khibina, Kola, contain He 0·0865 ml./g., Th 8·75 × 10^{-3} g./g., U 3·6 × 10^{-4} g., giving an age of 280 million years (Upper Devonian). Impure crystals w enclosures and the associated rocks show a large escape of helium. L. J. S.

[Baranov (V. I.) & Tzeitlin (S. G.)] Баранов (В. И.) и Цейтлин (С. Baranov (V. I.) and Zeitlin (S. G.). *Content of radioactive elements in so soils of the USSR.* Compt. Rend. (Doklady) Acad. Sci. URSS, 1941, vol. pp. 330–333.

The amount of radium in various types of soils is of the order 10^{-11} % and thorium 10^{-4} %, with larger amounts in soils derived from igneous and me morphic rocks than in those from sedimentary rocks. L. J. S.

ERLING (E. K.), KOMLEV (L. V.), SOKOLOVA (K. N.), & BARKAN (V. G.)] Герлинг (Э. К.), Комлев (Л. В.), Соколова (К. Н.) и Баркан (В. Г.) HERLING (E. K.) *et al. On the age of Lovozero tundras.* Compt. Rend. (Doklady) Acad. Sci. URSS, 1941, vol. 31, pp. 135–136.

The mineral loparite is especially valuable for radioactive age-determinations, ecause its close-packed structure and lack of cleavage ensures conservation of elium. A specimen from the Khibina massif and two from the Alluaiv mine, ovozero tundra, gave ages of 280, 266, and 231×10^6 years respectively; the last alue is discarded as the material was not perfectly fresh. M. H. H.

HLOPIN (V. G.) & ABIDOV (S. A.)] Хлопин (В. Г.) и Абидов (Ш. А.) CHLOPIN (V. G.) and ABIDOV (Sh. A.). *Radioactivity and helium content of beryllium, boron and lithium minerals in the USSR.* Compt. Rend. (Doklady) Acad. Sci. URSS, 1941, vol. 32, pp. 637–640.

Beryls of various ages from several localities contain He 0·026–6·430 mm.³/g. elium was also found in chrysoberyl, bertrandite, and helvine, but none in henakite (although this is richest in Be). The amount present shows no relation radioactivity, age, or beryllium content. Helium was also found in tourmaline, spodumene, and zinnwaldite. The various theories of the origin of this lium are mentioned; it seems most probable that the mineral absorbed shorted radioactive elements or helium from the magma. [M.A. **5**–477; **7**–407, 498.] L. J. S.

ONICH (V. K.) Монич (В. К.). *Absolute geological age of the granites of the Podnebesny pluton in the Kuznetsk Alatau.* Compt. Rend. (Doklady) Acad. Sci. URSS, 1941, vol. 33, pp. 262–265.

Petrographical descriptions and chemical analyses are given of the granites th exposures of more than 1000 sq. km. A porphyry-like granite gave U $1{\cdot}15 \times 10^{-6}$ g./g., Th $4{\cdot}4 \times 10^{-6}$ g./g., He $4{\cdot}77 \times 10^{-5}$ ml./g., corresponding to an age of 0 million years. Owing to loss of helium, this estimate is probably too low, d 250 million years (Upper Palaeozic) is assumed. L. J. S.

RLING (E. K.) Герлинг (Э. К.). *Age of the earth according to radioactivity data.* Compt. Rend. (Doklady) Acad. Sci. URSS, 1942, vol. 34, pp. 259–261.

A revision of the radioactivity data for the age of the earth, including an owance for the presence of lead not of radioactive origin, leads to an age of $1{\cdot}4 \times 10^9$ years. M. H. H.

RLING (E. K.) & STARIK (I. E.) Герлинг (Э. К.) и Старик (И. Е.). *Age of pyroxenite intrusions of Afrikanda and Ozernaya Varaca in the Kola Peninsula.* Compt. Rend. (Doklady) Acad. Sci. URSS, 1942, vol. 35, pp. 153–154.

Determinations of He ($9{\cdot}8$ and $5{\cdot}27 \times 10^{-4}$ g./g.), Ra ($6{\cdot}55$ and $2{\cdot}40 \times 10^{-12}$ g./g.), l Th ($1{\cdot}84$ and $2{\cdot}28 \times 10^{-5}$ g./g.) in two specimens of schorlomite from pyroxenites e the age as 344 and 338 million years respectively, corresponding to the rian period. This agrees with a previous determination (358 million years) ained with knopite from the same rocks. L. J. S.

Gerling (E. K.) & Vladimirova (M. E.) Герлинг (Э. К.) и Владимирова (М. Е.) *Age of pegmatite veins of the Ilmen reserve in the Urals.* Compt. Rend. (Doklady) Acad. Sci. URSS, 1942, vol. 37, pp. 179–184, 5 figs.

Samarskite containing only 0·63 % H_2O and not in a metamict state gave He 3·41 mg./g., U 0·1038 g./g., and Th 0·0503 g./g., corresponding to an age of 248 million years. Aeschynite gave He 0·591, Th 0·0901, corresponding to 71 million years. When heated, the samarskite gave off hydrogen (1·66 mg./g. at 600° C.), and the bulk of the helium not till 900° C. The aeschynite yielded only 20 % of its helium at 1200° C. L. J. S.

Clays

Nagelschmidt (G.). *The mineralogy of soil colloids.* Imp. Bur. Soil Sci. Harpenden, 1944, technical communication no. 42, 33 pp., 2 figs. Price 2*s.* 6*d.*

A useful résumé to date of the methods of investigation of clay minerals followed by a description of the minerals of soil colloids and their properties. An extensive bibliography is listed and X-ray diffraction data and optical properties of clay minerals are tabulated. F. A. B.

Legget (R. F.). *A note on the engineering significance of the clay minerals.* Univ. Toronto Studies, Geol. Ser., 1943, no. 48, pp. 43–48.

Some of the mineralogical properties of clay minerals are important in connexion with the design of foundations, dams, and reservoirs. M. A. P.

Ross (Clarence S.). *Clays and soils in relation to geologic processes.* (Presidential address, Geol. Soc. Washington.) Journ. Washington Acad. Sci., 1943, vol. 33, pp. 225–235.

The crystal-structure, chemical composition, and conditions for the formation in rocks and soils are compared and discussed for the three main groups of clay minerals—kaolinite, montmorillonite, and bravaisite (hydrous mica or illite). L. J. S.

Grim (Ralph E.) & Rowland (Richards A.). *Differential thermal analysis of clay minerals and other hydrous materials.* Amer. Min., 1942, vol. 27, pp. 746–761, 801–818, 14 figs.

Differential thermal curves are presented for many clay minerals. Kaolinite and halloysite-type clays are characterized by a sharp endothermic reaction between 500° and 600° C., and by a very abrupt exothermic reaction about 950° C. Hydrated halloysites show an additional sharp endothermic reaction between 100° and 200° C. Illite gives endothermic reactions between 100° and 250°, 500° and 650°, and at about 900° C., the last immediately followed by an exothermic peak. Montmorillonite is similar, save that the second endothermic reaction is at about 600–700° C. The thermal evidence indicates that many bentonites and other clays, thought to be monomineralic, are mixtures of illite and montmorillonite or of kaolinite and/or halloysite and montmorillonite. Th

pe and other specimens of beidellite are mixtures. Type bravaisite and a ecimen of celadonite are similar to illite. Smectite and leverrierite prove to be ontmorillonite. Dillnite, severite, miloschite, and collyrite give curves and tics similar to kaolinite and/or halloysite; newtonite is akin but with several all peaks on the curve indicating impurities. Various samples labelled volkonoite, racewinite, and allophane prove to be mixtures; while attapulgite, the ite magnesian clay mineral [hectorite] from Hector, California, cimolite, and ctorite yield differential thermal curves different from those of the other clay nerals.

C. F. D.

HAFER (G. M.) & RUSSELL (M. B.). *The thermal method as a quantitative measure of clay mineral content.* Soil Sci., 1942, vol. 53, pp. 353–364, 4 figs.

Norton's method of differential thermal analysis is to heat simultaneously a y sample and an equal volume of an inert material. Thermocouples register ntinuously the difference in temperature between the clay and the inert material d also the temperature of the latter. Plotting the temperature difference and temperature of the inert material reveals the endothermic and exothermic nts of the given clay sample. Standard curves have been obtained for samples montmorillonite, kaolinite, halloysite, metahalloysite, and illite from known alities separately after hydrogen-saturation and calcium-saturation. Thermal ves have also been obtained for these clay minerals when diluted with alumina l also mixed in pairs. It is found that this method permits the estimation of relative amounts of each component satisfactorily in mixtures of kaolinite l halloysite and of montmorillonite and kaolinite.

F. A. B.

MBERT (R. P.) & SHAW (Byron). *Studies of clay particles with the electron microscope: I. Shapes of clay particles.* Soil Sci., 1941, vol. 52, pp. 481–487, 10 figs.

RSHALL (C. E.), HUMBERT (R. P.), SHAW (B. T.), & CALDWELL (O. G.). —— *II. The fractionation of beidellite, nontronite, magnesium bentonite and attapulgite.* Soil. Sci., 1942, vol. 54, pp. 149–158, 12 figs.

LLEY (O. J.) & SHAW (B. T.). —— *III. Hydrodynamic considerations in relation to shape of particles.* Proc. Soil Sci. Soc. Amer., 1943, vol. 7 (for 1942), pp. 58–68, 17 figs.

teproductions of electron microscope photographs of dickite, beidellite, nonite, magnesium-bentonite, chrysotile, and attapulgite are given revealing crystal habit, in some instances not previously known, e.g. magnesium-tonite occurs as blades more elongated than those of nontronite. Attapulgite ws a striking resemblance to asbestos. The third paper discusses an equation ting the thickness of clay particles with the settling velocity and the cross-ion of the particles, which can be measured from electron microscope photo-hs. Thickness calculations are given for various fractions of quartz, kaolinite, bentonite. The separation of rod-shaped particles (e.g. halloysite) on the s of settling velocity is not as accurate as for disk-shaped particles.

F. A. B.

Shaw (B. T.) & Humbert (R. P.). *Electron micrographs of clay minerals.* Pro Soil Sci. Soc. Amer., [1942], vol. 6 (for 1941), pp. 146–149, 11 figs.

A description of photographs with the electron microscope of montmorillon (amorphous, fluffy to thin plates), nontronite (flat fibres), kaolinite (hexagon plates), dickite (thicker hexagonal plates), and halloysite (long, split rods). F. A. B.

Humbert (R. P.). *Particle shape and the behavior of clay as revealed by the elec microscope.* Bull. Amer. Ceramic Soc., 1942, vol. 21, pp. 260–263, 12 fig.

The paper presents a series of electron photomicrographs of montmorillon it nontronite, illite, beidellite, 'hectorite' (a magnesium-bentonite from Hec California), kaolinite, dickite, and halloysite. C. F. I.

Humbert (R. P.) & Marshall (C. E.). *Mineralogical and chemical studies of formation from acid and basic igneous rocks in Missouri.* Res. Bull. U Missouri Agric. Exp. Station, 1943, no. 359, 60 pp., 49 figs.

Thin sections of granite-porphyry and of diabase in various stages of dec position from neighbouring outcrops in SE. Missouri show in the granite t secondary minerals chlorite, epidote, sericite, and clay minerals; and in the d base chlorite, epidote, calcite, magnesite. Mechanical and chemical analyses a mineral separations were made of the resulting soils taken at different dept The electron microscope shows that the clay mineral is mainly beidellite wi some halloysite and magnesium-bentonite. L. J. S.

Hendricks (Sterling B.) & Alexander (Lyle T.). *Minerals present in s colloids: I. Descriptions and methods for identification.* Soil Sci., 19 vol. 48, pp. 257–272, 2 pls., 1 fig.

Alexander (L. T.), Hendricks (S. B.), & Nelson (R. A.). —— *II. Estimation some representative soils.* Ibid., pp. 273–279, 1 fig.

A description of the chemical, thermal, and X-ray methods used for mine identification in soils. The second paper gives the results of applying th methods to the fine fraction of 15 soils from the U.S.A. Red podzolic soils cons chiefly of kaolinite, free oxides and hydrous oxides of iron, whereas grey-bro soils contain illite in addition. F. A. B.

Jackson (M. L.) & Hellman (N. N.). *X-ray diffraction procedure for posit differentiation of montmorillonite from hydrous mica.* Proc. Soil Sci. S Amer., [1942], vol. 6 (for 1941), pp. 133–145, 1 fig.

Hellman (N. N.), Aldrich (D. G.), & Jackson (M. L.). *Further note on an X- diffraction procedure for the positive differentiation of montmorillonite fr hydrous mica.* Proc. Soil Sci. Soc. Amer., 1943, vol. 7 (for 1942), pp. 19 200, 1 fig.

A detailed study of the variation in position and intensity of the first-or basal spacing of numerous clay samples prepared mostly from soils and bent ites by various techniques. Calcium-saturated montmorillonite yields a spac

001) of 15–16 Å., whereas hydrous mica [illite] after saturation with calcium ields a spacing (002) of 12–13 Å. The optimum distinction is obtained when mples of the clays are dried from benzene rather than water. This procedure is pplied to a number of fine clays from soils and bentonites. Minerals of the ontmorillonite group are the dominant constituents, and no fine clay from soil as found consisting chiefly of hydrous mica [illite]. The second paper modifies ie above procedure chiefly by drying the sample in air of 65 % relative humidity id exposing to X-rays in an atmosphere of 92 % relative humidity. X-ray tterns of mixtures of montmorillonite and hydrous mica made up of known roportions provide the means for a quantitative estimation of these minerals in il samples. It is considered that the change of basal spacing of hydrous mica lite] from 10 Å. to 13 Å. for calcium-saturated material reveals a limited capacity r reversible shrinkage and expansion similar to that for montmorillonite.

F. A. B.

oss (Clarence S.) & Hendricks (Sterling B.). *Clay minerals of the montmorillonite group: their mineral and chemical relationships and the factors controlling base exchange.* Proc. Soil Sci. Soc. Amer., [1942], vol. 6 (for 1941), pp. 58–62.

A discussion of the chemical formulae of montmorillonite, beidellite, saponite, ntronite, and aluminian nontronite based upon chemical analyses of a hundred ineral specimens. Base-exchange can be due either to replacement of ions in tahedral co-ordination or to replacement of Si by Al. F. A. B.

ldwell (O. G.) & Marshall (C. E.). *A study of some chemical and physical properties of the clay minerals nontronite, attapulgite and saponite.* Res. Bull. Univ. Missouri Agric. Exp. Station, 1942, no. 354, 51 pp., 13 figs.

A review is given of the literature on nontronite, attapulgite, and saponite, bulating chemical analyses and physical properties. Chemical analyses, aterial removed by electrodialysis, base-exchange, titration curves, dehydration rves, sp. gr., refractive indices at various temperatures, stability and coagulan are given for several fractions (particle-size 2–0·5 μ) for the following ys: nontronite from Sandy Ridge, North Carolina; attapulgite from Attalgus, Georgia; and 'saponite or magnesium bentonite clay' from Hector, lifornia [M.A. **6**–372; magnesium-bentonite, Min. Mag. **25**–636; hectorite, n. Mag. **26**–337]. Attapulgite shows a break in the dehydration curve at 0–270° C. and no break at high temperatures, suggesting a modification of adley's structure [M.A. **8**–81] by putting 10(OH) groups in the brucite layers tead of $4H_2O$ and 2(OH). L. J. S.

exander (Lyle T.), Hendricks (Sterling B.), & Faust (George T.). *Occurrence of gibbsite in some soil-forming minerals.* Proc. Soil Sci. Soc. Amer., [1942], vol. 6 (for 1941), pp. 52–57, 1 fig.

Gibbsite and kaolinite have been determined by thermal methods in the athered crust and soil colloids derived from amphibolites, norites, epidote-ist, diabase, and muscovite-biotite-schists. Chemical analyses of the original l derived rocks are given. Gibbsite results from the alteration of the more

calcic plagioclase felspars, aluminous hornblende, epidote, and biotite. Gibbsite changes to kaolinite when silica is available from the weathering of minerals in close proximity. F. A. B.

Ensminger (L. E.) & Gieseking (J. E.). *The adsorption of proteins by montmorillonite clays and its effect on base-exchange capacity.* Soil Sci., 1941, vol. 51, pp. 125–132, 1 fig.

Describes similar results [M.A. **8**–82] with varying quantities of other proteins—haemoglobin, casein, protamine, pepsin, and pancreatin. The highest spacing obtained for (001) was 48·0 Å. with 2:1 of casein to montmorillonite. The base-exchange capacity of montmorillonite is decreased by adsorption of protein, especially for low *p*H values. F. A. B.

Bosazza (V. L.). *Further notes on the adsorption of malachite green by some clay minerals.* Amer. Min., 1941, vol. 26, pp. 396–402, 1 fig.

Details of experiments previously reported [M.A. **8**–296]. Chemical analyses are given of the materials (montmorillonite, kaolinite, and pyrophyllite) examined. L. J. S.

Bosazza (V. L.). *Occurrence of a coarsely crystalline kaolin mineral in some South African fire-clays.* Amer. Min., 1941, vol. 26, pp. 290–292, 3 figs.

Small nodules in fire-clay from Boksburg, Transvaal, show irregular flakes (up to 2 mm. long) with α 1·560, β 1·564, and strain shadows similar to the brushes of a biaxial interference-figure. Analysis agrees with $Al_2O_3.2SiO_2.2H_2O$, suggesting kaolinite, though the refractive indices are somewhat low. L. J. S.

Taylor (B. L.). *Decomposed granite, Baton, Nelson.* New Zealand Journ. Sci. Techn., Sect. B, 1944, vol. 25 (for 1943), pp. 78–86, 1 fig. (map).

A clay, possibly formed by hydrothermal action, occurs in zones of crushed and decomposed granite; it is pale grey, whereas the weathered granite is pale yellow. Mechanical and chemical analyses are given, and the material is compared with the Cornish china-clay and china-stone. Deposits of clay, derived from the granite, also occur in Tertiary beds and in recent alluvial deposits. L. J. S.

Willett (R. W.). *Feldspathic clay, Wyndham, Southland.* New Zealand Journ. Sci. Techn., Sect. B, 1944, vol. 25 (for 1943), pp. 87–88.

A layer of grey-white clay is interbedded in greywacke and argillite. Chemical analyses indicate the presence of considerable amounts of felspar and quartz. L. J. S.

Pinsker (Z. G.), Tatarinova (L. I.), & Novikova (V. A.) Пинскер (З. Г.), Татаринова (Л. И.) и Новикова (В. А.). *On the solubility of kaolin in water.* Compt. Rend. (Doklady) Acad. Sci. URSS, 1941, vol. 33, pp. 231–232.

A suspension in water of powdered nacrite from Simferopol, Crimea, was

owed to settle and the thin suspension passed through filter-paper. Drops of filtered liquid dried on a celluloid film gave a good electron diffraction ttern, indicating the presence of minute crystals. After two ultra-filtrations ough a collodion filter a faint pattern was still visible, indicating the solubility the material. L. J. S.

JSUPOVA (S. M.)] Юсупова (С. М.) YUSSUPOVA (S. M.). *The benthonite clays of Changhyr-tash.* Compt. Rend. (Doklady) Acad. Sci. URSS, 1941, vol. 33, pp. 259–261.

Chemical analyses and the absorptive and decolorizing properties are given five bentonitic clays from Uzbekistan, consisting largely of montmorillonite h vermiculite, sericite, and quartz. The conditions for their formation are cussed. L. J. S.

DLETZKY (I. D.) Седлецкий (И. Д.). *Subdivision of colloid-dispersed minerals of the montmorillonite group.* Comp. Rend. (Doklady) Acad. Sci. URSS, 1942, vol. 34, pp. 130–133.

Several chemical formulae have been given for montmorillonite, which really resent an isomorphous group of individual minerals. Further formulae are gested (giving a total of 19). A general formula is n(Ca,Mg,Na_2,H_2,&c.). O_3.3–5SiO_2.xH_2O. L. J. S.

DLETZKY (I. D.) Седлецкий (И. Д.). *Colloid-dispersion mineralogy, its problems and methods.* Compt. Rend. (Doklady) Acad. Sci. URSS, 1942, vol. 34, pp. 165–170.

The study of soils, clays, and muds by X-rays, electron diffraction, and mal analysis opens up a new branch of sedimentary petrography for which following general laws are enumerated. '(1) The composition of the colloid-ersive minerals in friable rocks is in no way determined by the initial rocks, solely by the character of the weathering process. (2) The composition of oid-dispersive minerals formed by weathering of different rocks represents a genetic association of argillites determined by the conditions of weathering. The paragenesis of elements forming such fractions depends on the paragenesis olloid-dispersive minerals. (4) The genesis of colloid-dispersive minerals is ed up with the conditions of the medium. The minerals of the montmoril-te group are formed under neutral or alkaline conditions whereas the kaolin up of minerals arise in an acid medium. (5) The weathering of rocks goes ugh a series of consecutive stages whose duration is determined by the sico-geographical and climatic conditions.' L. J. S.

OGRADOV (A. P.) & BOICHENKO (E. A.) Виноградов (А. П.) и Бойченко (E. A.) *Decomposition of kaolin by diatoms.* Compt. Rend. (Doklady) Acad. Sci. URSS, 1942, vol. 37, pp. 135–138.

ltures of diatoms with nacrite and agar extracted silica for their skeletons ing Al hydrate. Bacteria have no similar action. L. J. S.

Maegdefrau (Edmund) & Hofmann (Ulrich). *Die Kristallstruktur des Mon morillonits.* Zeits. Krist., 1937, vol. 98, pp. 299–323, 3 figs.

The photometry of X-ray photographs of samples of montmorillonite of know composition and water content mainly confirms the pyrophyllite-like structu previously described [M.A. **5**–474]. The authors also discuss the presence photographs of the (*hk*0) and (00*l*) spectra only. The dehydration of montmor lonite is considered to be continuous. F. A. B.

Edelman (C. H.) & Favejee (J. Ch. L.). *On the crystal structure of montmor lonite and halloysite.* Zeits. Krist., 1940, vol. 102, pp. 417–431, 8 figs.

Although owing to the absence of (*hkl*) diffractions no X-ray evidence can adduced, the crystal-structures now suggested are considered to explain physical properties of montmorillonite and halloysite more satisfactorily t do those already put forward. In place of the sheets of $(Si,Al)_2O_5$, linked by or Mg ions in octahedral co-ordination with oxygen separated by hexago layers of water molecules, another type of sheet-like structure has been deri for montmorillonite from the [111] direction of the high-cristobalite structu dimensionally equivalent but affording surface layers of hydroxyl ions which authors consider are essential for the swelling and base-exchange properties the mineral. In this way the formula of montmorillonite can be writt $Al_2(OH)_4O_2Si_4O_6(OH)_2.nH_2O$, and similarly for halloysite $Al_2(OH)_5OSi_2O_3.H_2O$ F. A. B.

Hofmann (U.) & Hausdorf (A.). *Kristallstruktur und innerkristalline Quellu des Montmorillonits.* Zeits. Krist., 1942, vol. 104, pp. 265–293, 7 figs.

The crystal-structure for montmorillonite suggested by Edelman and Favej [preceding abstract] is contradicted by the dehydration curve and the te numerous surface hydroxyl ions which would be available for base-exchange their structure. An X-ray investigation has been resumed on the dehydration montmorillonite prepared from various localities including Bradley, Grim, a Clark's own preparations [M.A. **7**–98]. The latters' results have been confirme and it is suggested that only specially prepared samples of the mineral can sho the existence of stoichiometric hydrates and that powdered montmorillonite general shows a continuous decrease in the *c* spacing with decrease in wat content owing to lack of uniformity in the sample. F. A. B.

Endell (Joachim), Zorn (Renate), & Hofmann (U.). *Über die Prüfung a Montmorillonit mit Benzidin.* Angew. Chem., 1941, vol. 54, pp. 376–377.

Most, but not all, specimens of montmorillonite from various localities ga a blue colour with benzidine. On the other hand, some specimens of quar kaolinite, mica, and nontronite gave a positive reaction. The test is not reliab for the identification of montmorillonite in clays. L. J. S.

Bujor (D. Jonescu). *Elektronmikroskopische Untersuchung der Montmorillon bildung aus zersetztem Biotit.* Neues Jahrb. Min. Monatshefte, Abt. A, 194 pp. 25–32, 18 figs.

A clay derived from liparite at Tomeşti, Caras, Romania, shows under t

ctron microscope in the fraction $< 3\,\mu$ montmorillonite, kaolinite, biotite, l silica gel, the flakes of biotite being rimmed and replaced by montmorillonite. L. J. S.

Miscellaneous

RVEY (C. O.). *Some notes on the calculation of molecular formulae for glauconite.* Amer. Min., 1943, vol. 28, pp. 541–543.

The trial and error method of Hendricks and Ross [M.A. **8**–275] is criticized and nore direct method given on the primary assumption that the formula contains $(OH)_2$. The analysis of glauconite from Chobham Common, Surrey [M.A. 1], is used as an example. L. J. S.

RVEY (C. O.). *Determination of tin with special reference to tin ores.* Wartime Pamphlet Geol. Surv. Great Britain, 1943, no. 35, 13 pp., 2 figs. Price 9*d*.

The tin is determined in low-grade tin ores by decomposition of the mineral owed by distillation as halide and iodimetric estimation. C. F. D.

DER (Rex T.). *Fibroferrite and copiapite from Yetar Spring, near Chidlows.* Journ. Roy. Soc. Western Australia, 1943, vol. 28 (for 1941–2), pp. 79–82, 1 fig.

A surface incrustation on diatomite at this mineral spring in Western Australia sists of a mixture of white fibroferrite (minute acicular forms, positive igation, α 1·553, γ 1·600), colourless melanterite, and yellow copiapite (γ 1·578; lysis calculated as $(Na_2,Mg)_{0\cdot97}(OH)_{1\cdot94}.Fe'''_{3\cdot78}(SO_4)_{6\cdot00}.16\cdot58H_2O$). Small ips of fibroferrite contain a copiapite core. The minerals are believed to be ived from sub-surface pyrite. C. F. D.

TTON (C. O.). *Some features of heavy mineral separations.* Trans. Roy. Soc. New Zealand, 1943, vol. 73, pp. 76–83, 5 figs.

comparison of data obtained in separating a sediment of fine-sand grade by separating funnel, (2) by centrifuge. Centrifuging is found to be essential reatment of material containing over 20% finer than very-fine-sand grade. C. F. D.

LLARD (G. W.). *Raw quartz, its impurities and inspection.* Bell System Technical Journ., New York, 1943, vol. 22, pp. 338–361, 15 figs.

arious defects and imperfections found in some piezoelectric quartz are listed, an inspection apparatus ('quartz inspectoscope') is described in detail. lusions are classified as bubbles, needles (dark, blue, white, or chuva), phan- s, veils, and clouds. Chuva is a special type of white needle inclusion with ll bubbles, giving the appearance of dew-drops along a thin fibre. C. F. D.

IIN (N. G.) Сумин (Н. Г.). Цианотрихит Меднорудянского и Коунрадского месторождений. *Cyanotrichite from Mednorudiansk and Kounrad deposits.* Изв. Акад. Наук СССР, Серия Геол. (Bull. Acad. Sci. URSS, Sér. Géol.), 1941, no. 6, pp. 77–83 (Russian), 83–84 (English), 3 figs.

yanotrichite [lettsomite] from (I) Mednorudyansk, near Nizhne Tagil, and

(II) Kounrad [N. of Lake Balkhash] gives α pale blue, almost colourless, 1·591 1·588; β pale bluish, 1·620, 1·617; γ (= *c*) bright blue, 1·654, 1·656; 2V 8 *r* < *v* strong; sp. gr. 2·76. I with CuO 48·22, Al_2O_3 15·72, SO_3 13·22, H_2O 23 insol. 0·30 = 100·60. This is the first record from the U.S.S.R. C. F. D.

Volodchenkova (A. I.) & Melentiev (B. N.). *Apatites of two textural types f apatite-nepheline rocks of Chibiny.* Compt. Rend. (Doklady) Acad. URSS, 1943, vol. 39, pp. 34–35.

Average samples of apatite, irrespective of any morphological differen separated from the mottled (I) and breccia-like (II) types of rock gave analy showing no appreciable variation.

	P_2O_5.	SiO_2.	Rare-earths.	Fe_2O_3.	MnO.	MgO.	CaO.	SrO.	Na_2O.	K_2O.	F.	To
I.	41·00	0·68	0·93	0·05	0·11	trace	52·99	2·02	0·52	0·19	2·60	101·0
II.	40·62	0·26	0·98	0·29	0·07	0·01	52·85	2·57	1·10	0·21	1·79	10

L. J. S.

Berg (L. G.). *Influence of salt admixtures upon dissociation of dolomite.* Comp Rend. (Doklady) Acad. Sci. URSS, 1943, vol. 38, pp. 24–27, 6 figs.

On heating some samples of dolomite the first endothermal effect appea suddenly at about 730° C. accompanied by superheating; in other sampl dissociation begins at a considerably lower temperature without any supe heating. Those of the latter kind were found to contain chlorine, and when th was washed out their behaviour was normal. By the addition of very sma amounts of NaCl or other alkali salts the abnormal heating effect can be repr duced, the dissociation point falling to 490–520°. L. J. S.

Borovick (S. A.) [Borovik (S. A.) Боровик (С. А.)]. *Content of scandium beryls and some other minerals.* Compt. Rend. (Doklady) Acad. Sci. URS 1943, vol. 40, pp. 111–112.

Many beryls from various localities in U.S.S.R. were examined spectroscopical for scandium. The amounts found appear to vary with the colour and chromiu content of the mineral, from none in colourless beryl up to 0·03 % in emeral L. J. S.

Miropolsky (L. M.) & Borovick (S. A.). *Spectrum analysis data on gypsum fro Permian deposits of Tartary.* Compt. Rend. (Doklady) Acad. Sci. URS 1943, vol. 38, pp. 33–36.

Primary gypsum and secondary gypsum derived from anhydrite or recrysta lized from solution in fissures was examined for 55 elements and 15 were foun Mg, Si, Ca, Ti, Fe, and Sr are always present; B, Al, Mn, and Cu are met wit frequently; Li, Be, Yt, Zr, and Bi occur sporadically as traces. No difference shown by material from different stratigraphical horizons. The secondar recrystallized gypsum is the purest. Colour of the material is correlated with th amounts of Fe, Ti, and Cu. L. J. S.

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